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MODIS On-orbit Characterization Using the Moon

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ABSTRACT

The MODIS Protoflight Model (PFM) on-board the Terra spacecraft has been in operation for more than two and half years since its launch on December 18, 1999. In addition to the on-board calibrators (OBCs), the observations of the moon have been planned monthly with carefully chosen viewing conditions. The data from these observations is used to support the instrument s on-orbit calibration and characterization. In this paper, we describe the use of lunar observations for monitoring the MODIS reflective solar bands (RSB) radiometric stability and discuss related applications. For Terra MODIS, the lunar views have also been used to derive correction parameters for the optical leak among the photoconductive (PC) detectors (bands 31-36), to characterize the electronic crosstalk under different focal plane operational configurations, and to track on-orbit band-to-band registration (BBR). The same strategies are being applied to the Aqua MODIS (Flight Model 1 - FM1) launched on May 4, 2002. The lunar observation results from both instruments are compared.

Keywords: MODIS, Moon, calibration, optical leak, electronic crosstalk, radiometric stability

1. INTRODUCTION

The MODerate Resolution Imaging Spectroradiometer (MODIS) is the keystone instrument for the NASA Earth Observing System (EOS)[1]. Both EOS Terra and Aqua satellites carry a MODIS instrument with Terra in a 10:30AM (local time) equator crossing orbit and Aqua in a 1:30 PM orbit. The Protoflight Model (PFM) on-board the Terra spacecraft has been in operation for more than two and half years since its launch on December 18, 1999. The Flight Model (FM1) was launched on May 4, 2002 on-board the Aqua spacecraft. The two instruments provide complementing morning and afternoon global observations for the studies of the Earth/Atmosphere system.

The MODIS instrument provides measurements in 36 spectral bands with wavelengths from 0.412μ (VIS) to 14.5μ (LWIR) at three nadir spatial resolutions: 2 bands at 250m, 5 bands at 500m, and 29 bands at 1km. It is a cross-track scanning radiometer with a two-sided paddle wheel scan mirror, providing a swath of 10km (nadir) along-track by 2330km cross-track every scan (1.478 sec.). Figure 1 is a schematic of the MODIS scanning sequence. The rotating scan mirror allows the sensor to view the on-board calibrators (OBCs) and the Earth scene every scan. The OBCs include a solar diffuser panel used for calibration of the reflective solar bands (RSB), bands 1-19, and 26 with wavelengths from 0.412μ to 2.1μ, and a v-grooved blackbody for calibration of the thermal emissive bands (TEB), bands 20-25 and 27-36 with wavelengths from 3.75μ to 14.5μ[2-5]. Any degradation of the SD is monitored using a solar diffuser stability monitor (SDSM) during each SD calibration via alternate views of the direct Sun light and the reflected Sun light from the SD. Another on-board device, the spectroradiometric calibration assembly (SRCA), is used to monitor the sensor s on-orbit spatial and spectral characterization[6].

Since the Moon provides a good radiometric reference for the Earth-orbiting sensors with its stable surface reflectance and irradiance[7-10], it has been used by the MODIS to monitor detector response stability in the visible (VIS) and near-infrared (NIR) spectral regions. In this paper, we will briefly review the method used for the response stability monitoring and provide the results for the Terra MODIS since it has been in operation for over two and half years. In addition, the Moon has been used for other on-orbit calibration and characterization activities. These include deriving correction parameters for the Terra MODIS optical leak among the photoconductive (PC) detectors (bands 31-36), characterizing the electronic crosstalk under different focal plane operational configurations, and tracking changes in the

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